MATH 4400-001 – Linear Programming – Fall 2019 – Syllabus
T, Th, 12:30 – 1:45 p.m., Martin M-103

Instructor: Dr. Margaret Wiecek

Office: Martin Hall O-208, ph: 656-5245, e-mail: wmalgor@clemson.edu
Office hours: T, Th 11:00 a.m. – 12:00 p.m. or by appointment.
Prerequisite: MATH 2060, 3110, or consent of instructor

Required Text: J. G. Ecker and M. Kupferschmid, *Introduction to Operations Research,* Kreuger, 1988 or a later reprint.
The textbook should be brought to class each day.

Software: - LINDO: go to https://www.lindo.com/index.php/ls-downloads and click on Download Classic LINDO to download a free demo version, or
- MATLAB available at CU labs, or
- software approved by the instructor

Goal: Introduce students to linear programming (LP) models and methods used for solving decision-making problems in business and industry.

Topical outline and daily assignments: *expected # of classes**

0. Linear algebra review — 1
1. LP models and applications — 2
   H: 2.2a, 2.3, 2.4, 2.11, 2.13, 2.14, 2.15, 2.17, 2.18.
2. Simplex method — 9
   standard form, simplex tableau, pivoting,
   canonical form, optimal form, unbounded form, infeasible form,
   simplex algorithm (SA), artificial variables, Phase I and Phase II
   H: 3.1a, b; 3.2a, b; 3.3; 3.4a; 3.5; 3.6; 3.7; 3.8b; 3.9; 3.10a, b, c; 3.12; 3.16; 3.17; 3.18; 3.20b; 3.21; 3.22; 3.23a, b, d, e, f, g, h, i; 3.25, 3.27; 3.30.
3. Geometry of LP and SA — 2
   H: 4.2; 4.3; 4.4; 4.5 a, b, c; 4.6; 4.10.
4. Duality in LP — 4
   duality relations, primal and dual solution,
   economic interpretation of dual variables,
   dual simplex method
   H: 5.1; 5.2; 5.3; 5.6; 5.7; 5.8; 5.9; 5.10a, b; 5.11; 5.14a, b; 5.16; 5.17; 5.18.
5. Sensitivity analysis in LP — 2
   changes in available resources,
   changes in selling prices,
   adding new products or constraints
   H: 6.1; 6.3a, c, e, g, h, i; 6.4b, c, d, e; 6.5a, b, c.
6. Network flow problems — 6
   transportation problem,
   network flow problem
   H: 7.1a; 7.2; 7.3; 7.5a; 7.7; 7.9a; 7.11; 7.12a; 7.16; 7.17.

* The pace may be adjusted at the instructor's discretion.

Student learning objectives: Upon successful completion of this course, a student will be able to
- develop LP models for a class of decision-making problems
- solve smaller-LP problems analytically
- solve LP problems using software
- analyze LP models to get additional insight into the real-life problem

Calculators: A (simple) calculator is recommended. Students may use their preferred calculators and are responsible for their use. Calculator related questions will not be answered in class.

Electronic equipment: Small electronic equipment (cell phones, iPods, etc.) is not allowed in class.

Classroom attendance: The University does not have an attendance policy and I do not have a specific attendance policy either. Should you decide that you do not need to come to class, be sure you get the information from a classmate. Do not come to see me about missed material unless you have a valid excuse for the absence. If you do have a valid excuse, I will be glad to help.

Class cancellation: A class is canceled 15 minutes after the instructor fails to arrive.

Inclement weather: Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor.

Academic Continuity Plan: Should university administration officially determine that the physical classroom facility is not available to conduct classes in, class will be conducted in a virtual (online) format. When notified, use one of the following links to navigate to Clemson Canvas where you will find important information about how we will conduct class:

Primary access link: www.clemson.edu/canva
Secondary access link, if needed: https://clemson.instructure.com/
You can also use the Canvas Student App.

On E-Learning Day, August 29, 2019, a real-time test of the Academic Continuity Plan will be conducted. In Canvas, in a module entitled "E-Learning Day, August 29, 2019" you will find a description of the assignment for that day.

Daily assignments: Daily assignments are given above but may not be assigned in class on a daily basis. It is your responsibility to read along in the textbook and work the problems as they are given in the syllabus for each topic presented and discussed in class. It will be difficult to succeed in this course without doing homework problems on a daily basis.

Quizzes: 10-20 minute quizzes based on class work or daily assignments will be given weekly. The quizzes will be closed-book and pertain to the most fundamental issues of

linear algebra and LP. The quizzes **will not be announced**. A calculator is the only electronic tool to be used but is not required.

There will be **no make-up quizzes** but a small number of lowest scores will be dropped at the end of the semester.

Exams: There will be three **in-class closed-book** exams: **September 17 -** Exam 1; **October 22 -** Exam 2; **November 19 -** Exam 3. These test dates are subject to change at instructor's discretion. A calculator is the only electronic tool to be used but is not required.

There will be **no make-up exam.** If you are absent on the day of an exam, you must notify the instructor before the test and present a written official proof of your absence if you want to have your next exam grade doubled. Otherwise you receive no credit. The only excuses for missing a quiz or exam are illness, family problems or university official events. Students who are late in class on exam days will not get additional time.

Project: Information about the project will be given after Exam 2. The project will be due **November 26**.

Final Exam: Monday, **December 9, 2019, 3:00 - 5:30 p.m., Martin M-103**.
No exemptions from the final exam will be offered.

Grading:	quizzes	15%
	3 exams	45% (15% each)
	project	15%
	final exam	25%

Grading scale: A (90-100); B (80-89); C (70-79); D (60-69); F (59 and below)

Final grades: In general, the grading scale will be followed, however, the instructor reserves the right to consider class participation, quality and neatness of work, general attitude and cooperation etc. in deciding final grades.

Accessibility: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the professor know, and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen if at all possible, but there could be a significant wait due to scheduled appointments. Students who receive Academic Access Letters are strongly encouraged to request, obtain and present these to their professors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to

follow this process each semester. You can access further information here: http://www.clemson.edu/campus-life/campus-services/sds/.

Academic Integrity Policy will be strictly enforced (see Student Handbook).
As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a high seminary of learning. Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

The Clemson University Title IX: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This policy is located at http://www.clemson.edu/campus-life/campus-services/access/title-ix/. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 110 Holtzendorff Hall, 864.656.3181 (voice) or 864.656.0899 (TDD).

How to succeed in this class?

- Master linear algebra: elementary row operations and solving systems of linear equations

- Avoid arithmetic mistakes

- Be attentive to details

- Come to class

- Work on homework assignments

MATH 4400-100 – Fall 2019 – Supplement to MATH 4400-001 Syllabus

The students enrolled in MATH 4400-100 will work additionally on **a modeling project**. They will conduct an independent study in the area of application of LP models in business, management, or engineering.

The study will include investigation of **three real-life situations** for which an LP model has been developed in the operations research literature. The selected real-life situations should be distinctly different from each other and different from those seen in class or textbook. They may include real life data or be based on models in the operations research literature. Use of library and internet is encouraged.

The students are to submit a report on each of the three LP models. The following format of the reports is required:

1. Description of the real-life situation of interest.
2. Motivation for using optimization.
3. Development of a model:
    a. definition of decision variables
    b. formulation of an objective function
    c. formulation of constraints
4. Overall model formulation.
5. Your judgement about the suitability of the model.
6. References (all references including internet pages with the dates of accessing them should be included in the report).

Length of the report: 2-3 pages without figures and references. The report should be typed.

Due dates for the reports: **October 1; November 5; December 3**

Grading: The grading scale of MTHS 4400-001 will be followed with the exception of the project grade.
1. The final grade for the modeling project will be determined as the average of the three grades for the reports submitted. The grades will be lowered 10% or more for late submission.
2. The overall project grade will be determined as the following weighted average:
50% (4400-001 project) + 50% (4400-100 modeling project)

MATH 6400-001- Fall 2019 – Supplement to MATH 4400-001Syllabus

The students enrolled in MATH 6400-001 will work on a project as given in the MATH 4400-001 syllabus. However, their project will be different from the MATH 4400-001 project.

The MATH 6400 project will involve an independent study in the area of applications of LP models in business, management or engineering resulting from a real-life situation of interest to the students or from the research the students pursue in the program of their studies. The details of the project will be discussed between each student and the instructor in a meeting. Please make an appointment immediately after September 17 (Exam 1) to discuss the project.

Grading: The grading scale of MTHS 4400-001 will be followed.